



VALENCE

ELECTRICAL TRAINING SERVICES

Do you want to be a
better relay tester?



About Valence Electrical Training Services

About Our Relay Training Center

Most protective relay training falls into three categories:

- Engineering books written for design engineers, not relay testers.
- Courses hosted by relay manufacturers specific to their relays.
- Test-set manufacturer, or automated test software, training focused on how to get their solution to test the relay with minimum user input.

We believe that:

- The power system is universal, and you can apply the same principles to any relay model or manufacturer
- All modern test-sets can test any modern relay.
- A skilled relay tester will always test a relay more effectively and efficiently than a button pusher, while fixing problems the alternatives will never discover.

All of our relay training material:

- Is written specifically for relay testers in plain language.
- Is designed to be universal and can be applied to any relay or any test-set.
- Includes the theory necessary to understand what is happening inside the relay, and why.
- Has universal, step-by-step procedures so the relay tester knows how to apply the theory.
- Uses the most efficient and effective relay testing techniques used today.

The Relay Testing Handbook Series

Valence Electrical Training Services started with a paper presented at a major electrical testing conference that turned into *The Relay Testing Handbook* series, a comprehensive series of nine books, each of which covers a specific relay testing topic. Any technician who has ever been faced with a confusing or challenging situation in the field will appreciate that a relay tester, not an engineer, wrote these books. This practical resource gives you the tools you need to test almost any type of protective relay, no matter who the manufacturer is.

Some of the topics included in The Relay Testing Handbook series include:

- Basic electrical fundamentals
- Basic relay testing fundamentals
- Relay testing equipment options and how to use them
- Information about the most common protective elements (50/51/67/59/27/81/87/21 protection) including:
 - Theory behind the element
 - How and when the element is applied
 - Step-by-step test procedures
 - Tips and tricks to overcome common problems
- Relay testing approaches and how to select the best ones
- Test plans with real-world applications
- Examples from multiple manufacturers and test-set models

Online Training

Online Protective Relay Training

Today's relay testers have to perform more work in less time, and typically have very little support to help them test modern digital relays that become more complex every year. We created *The Relay Testing Handbook* series as a practical reference guide for the modern relay tester, but studies have shown that most people must apply multiple learning styles before they fully understand a topic.

Each course in this online protective relay training series is based on a topic in *The Relay Testing Handbook*, and hits three key learning styles to ensure you retain the information and can start using it immediately in your day-to-day activities.

- You can read about the topic with excerpts from *The Relay Testing Handbook*.
- You will listen to a narrator while watching videos that discuss the topic in greater detail. You can learn at your own pace with controls that can pause, rewind, fast-forward, etc.
- You will use our interactive exercises that simulate the topic using the most realistic situations possible to help you learn by doing.



Our online protective relay training courses are designed to:

- Allow you to choose the topics most important to you.
- Complete the courses at a location and time convenient for you and your schedule.
- Focus on the skills you need to become a better relay tester.
- Be universally applied to any relay or test-set.

Each of our online relay training courses has the following structure:

- An introduction to the course topic with excerpts from *The Relay Testing Handbook* series
- A video series describing the topic with animations and examples
- A series of exercises to help you master the topic through real-world examples
- A quiz with real-world questions to see how much you've learned taking the course
- A certificate of achievement that can be used for continuing education credits.

Online Training Seminars

How to Test Protective Relays, 16 CEUs

This online protective relay testing seminar follows Chris Werstuiuk (author of The Relay Testing Handbook) as he tests a relay from start to finish. You'll learn the basic skills needed to test any digital relay with any modern test-set, how to perform each testing step, and why each step is important.

You'll see how to make smarter test plans that are quicker and more effective than traditional methods (including tips and tricks you won't find in any manual or YouTube video).

Watch this series of videos on any device with speakers or headphones, and a high-speed internet connection. The videos are broken down into logical chunks that you can watch at any time, and in any order, to fit this series into your busy schedule.

What do I get when I enroll in the "How to Test Protective Relays Online Seminar" today?

- Download a simple flowchart to follow to test while testing digital protective relay with any test-set.
- Unlimited access to 17+ hours of videos where Chris Werstuiuk tests various relays using different test-sets, and explains how he performs the test, and why.
- Content to download and follow along.
- Comment sections to ask Chris questions, and interact with other students.
- Ask for more content if you don't see your relay or test-set represented in the course.



"This is a fantastic course in how to test relays and covers aspects that are not found anywhere else - set up, print and documentation review, testing philosophy, the testing process and reporting results. The quality of the material in these videos and Chris's engaging delivery have led me to be infinitely more prepared to take on the task of relay testing than ever before."

Benjamin

How to Test Protective Relays Seminar

"Chris is extremely knowledgeable and experienced. He has seen almost every mistake that can be made in the protection and control game. This course will provide you with a great step-by-step guide to testing. Not only will you have a good guide, but you will understand WHY you are doing that step."

Student

How to Test Protective Relays Seminar

Online Training Seminars

How to Test Protective Relays, 16 CEUs (Continued)

This seminar explains how to test protective relays using Chris' decades of relay testing experience and nearly a decade of relay testing training to make smarter test plans that are more effective and more efficient than traditional test plans.

What do you cover in this online protective relay testing seminar?

We cover the following information using a variety of relays and test-sets for every topic:

Obtain and Review the Relay Settings, Drawings, and Application

- Obtain and Review the Relay AC Single-Line Drawings
- Obtain and Review the Relay AC Three-Line Drawings
- Obtain and Review the Relay DC Drawings
- Obtain and Review the Relay Main Settings
- Obtain and Review the Relay Logic Settings
- Obtain and Review the Relay Global and Port Settings

Create a Checklist of all Elements, Outputs, and Signals to be Tested

- Create a Checklist of All Elements to be Tested
- Create a Test Checklist of all Logic, Outputs, and Signals

Isolate the Relay From the System

- Understanding FT Style Test Switches
- Isolate the Relay From the System

Connect the Test Set to the relay

- Connect the Test-Set to the Relay
- Alternate DC Connections
- Alternate AC Connections

Upload the Relay Settings

- Upload Relay Settings

Perform an Acceptance Test

- Record the Relay Self-Test Results
- Check all Digital Inputs and Outputs
- Balanced Three-Phase Meter Tests
- Unbalanced Three-Phase Meter Tests
- Combined Meter Tests
- Perform a Meter Test – Open-Delta PTs

How to Test Protective Relay Elements

- Percent Error and Metering Specifications
- Relay and Element Specifications
- Understand the Basic Operation of the Element
- Understanding The Power System
- Choose the Appropriate Fault Type for the Test
- Perform Ramping Pickup Tests via Relay Setting Changes
- Perform Ramping Pickup Tests via HMI
- Perform Ramping Pickup Tests via Automatic Ramp
- Perform Ramping Pickup Tests via Hybrid Ramp
- Perform Manual Pulsing Pickup Tests
- Perform Automatic Pulsing Pickup Tests
- Perform Inverse Timing Tests
- Perform Instantaneous/Definite Time Timing Tests
- Perform Dynamic Pickup/Timing Tests

Perform a Commissioning Test

- Testing Physical Outputs
- Testing Virtual Outputs/Front Panel Display
- Testing Digital Logic
- Standard Pickup/Timing Tests
- Universal Pickup/Timing Tests
- Dynamic Pickup/Timing Tests

Perform Maintenance Tests

- Download All Settings, Events, and Meter Logs
- Perform Self-Test and Meter Tests
- Verify All External Inputs
- Verify that All Outputs Operate Correctly

Post Testing Tasks

- Clear Metering, Sequence of Event, and Oscillography
- Return The Relay to Service
- Submit Your Report

Online Training Courses

Course 1-1: The Three-Phase Electric Power System, 4 CEUs

Protective relays constantly look at the three-phase electric power system and try to decide whether the system is normal or under fault conditions. A relay tester who understands the three-phase electrical system can build highly efficient test plans to test the entire relay (not just the individual pieces of it) to make sure it actually operates when it's supposed to.

We will cover the following topics in this lesson to give you a foundation in three-phase electrical theory to help you become a craftsman instead of a button pusher:

Introduction to Electrical Fundamentals and Frequency

- How electricity is created
- What is a cycle
- How to count cycles
- Understand how frequency and cycles are related
- Converting cycles to seconds
- Converting seconds to cycles
- Converting cycles to cycles



Three-Phase Electric Power Systems

- How three-phase electric power systems are created
- How to determine which kind of three-phase electric power system is being generated
- How to change one kind of three-phase electric power into another

"I learned a lot from this course. Having no relay testing experience, I was grateful the real world examples were shown. I will definitely continue with this program, as they become available."

Joe

The Three-Phase Electric Power System

"Excellent refresher for someone in the field who doesn't deal with phasors and/or frequency/time/cycle conversions very often."

Student

The Three-Phase Electric Power System

Online Training Courses

Course 1-2: Phasor Drawings for Relay Testers , 4 CEUs

Phasor diagrams are used to understand the electrical system at a glance. Unfortunately, your test-set probably has a different phase angle system than your meter or relay, which can make relay testing a nightmare. How are you supposed to translate phase angles between devices that use different references?

This course introduces you to phasors in 7 detailed video lessons and quizzes, which cover:

- Understanding Phasors
- Drawing Phasor Drawings
- Drawing Phasors with Lagging Angles for GE SR Relays, Megger Equipment, and RTS Software
- Drawing Phasors with Different Scales

In a perfect world, these four lessons would be all you needed to become a phasor drawing master. Unfortunately, it seems every manufacturer has a different system for the angles in phasor drawings. The remaining lessons in this course help you understand all of the different angle systems used by all the major equipment vendors:

- Drawing Phasors with Positive Angles for Manta and Doble test-sets
- Drawing Phasors with Negative Angles for GE UR relays
- Drawing Phasors with Positive and Negative Angles for SEL, SIEMENS, ABB, and Alstom relays (and most equipment not listed)



"For people who feel they may know some details about relay testing but get confused by the different phase angles and phase rotation. It clears up the differences and opens your eyes to the need to be careful when trying to figure out phase rotation."

Customer Review

Phasor Drawings for Relay Testers

"If you want to take your relay testing knowledge to the next level, this course is a must!"

Student Course Evaluation

Phasor Drawings for Relay Testers

Protective Relay Testing Training

Effective, Hands-On Training for Relay Testers

Valence Electrical Training Services has shown its commitment to the high-voltage electrical testing industry with *The Relay Testing Handbook* series and our online training series. Many people we have met over the years have requested a complete training program so that their test technicians will be able to answer all of these questions:

- What is a protective relay?
- Where are protective relays used?
- Why do protective relays need to be tested?
- What are the most common protective relay functions?
- How do I test any protective relay or element?
- What are the most effective test techniques available?

Most protective relay training classes are equipment specific, include over 4 days of training, and are based on decades-old material. This means that the student only learns one way to test the relay, can become overloaded with too much or dated information, and requires overtime travelling to and from the training site.

We have combined all of our training experience to create a modern curriculum for today's relays and test equipment. Our class sizes, topics, and durations have been carefully planned to make sure our trainees actually retain the information they obtain in the class through a combination of theory and hands-on training. We use modern relays and techniques that can be applied to any modern test set from any manufacturer.

All of our in-person training classes include post-training services where students can ask those questions they didn't think of while attending the class and consult with relay testing experts to help them after the classes are complete.

While we focus on ensuring that students graduate with the knowledge and skills they need to become effective relay testers, we understand that recognition is also important. All of our graduates receive a certificate of completion that can be used with your regulating board, and each class has been pre-approved for the number of NETA Continuing Education Units (CTDs) listed in each class description.



Introduction to Modern Relay Testing

3-Day Class, 24 CEUs

Why do I want to take this class?

Modern protective relays can be extremely complex or relatively simple, depending on the relay model and design engineer. It is possible to use some testing techniques from previous relay generations, but these techniques only test individual elements which does not guarantee the relay is set correctly or will operate when required.

Most modern relay problems have nothing to do with the actual relay as supplied by the manufacturer. Today's relay problems occur when the relay has been incorrectly connected to the power system, or was set incorrectly by the design engineer. Unfortunately, these problems cannot be detected by traditional relay testing techniques that reprogram the relay in order to get the right test value for the test sheet. These techniques don't ask the right questions to find the problems that prevent the relay from operating and they are never discovered until the relay is needed most, and it fails to operate.

Modern relay testers must apply several different skill sets to effectively test digital relays so that they can get the test results they need for their reports, and make sure the relay is properly applied. This class provides the basic skills every modern relay tester should have, including:

- Understanding the power system
- Understanding why and how protective relays are applied
- Understand phasors and phasor diagrams
- Understanding what these numbers mean? (50/51/67/etc.)
- Comparing single-line, three-line, manufacturer, and DC drawings
- Communicate with relays and test-sets
- Building effective and efficient test plans
- Applying basic relay testing procedures
- Understanding digital relay logic



Day 1 Topics

1. Class Introduction
2. Power System Basics
3. Protective Relay Introduction
4. Phasor Diagrams

Day 2 Topics

1. Comparing Drawings
2. IEEE Designations
(50/51/67/etc.)
3. Communication Protocols
4. Communicating with Relays

Day 3 Topics

1. Understanding Relay Settings
2. Relay Testing Techniques
3. Digital Logic
4. Creating Test Plans
5. Applying Test Plans

Protective Relay Testing Fundamentals

3-Day Class, 24 CEUs

Why do I want to take this class?

Good relay testers need a solid foundation to build from, and the graduates from this program will understand and be able to test the most common functions enabled on any feeder relay such as:

- Time Overcurrent (51)
- Instantaneous Overcurrent (50)
- Overvoltage (59) / Undervoltage (27)
- CO-x or IAC-xx
- Schweitzer Engineering Laboratories SEL-351
- General Electric SR-750

Who should take this class?

We recommend that all relay technicians take the Protective Relay Testing Fundamentals class to ensure that they have a solid foundation before attending any of the other courses. We don't just discuss the mechanics of the topics above; we review all of the fundamentals that every relay tester should know.



Which prerequisites are required?

Prospective students should have a basic understanding of the power system such as Watts, VARs, Ohm's Law, etc.

Day 1 Topics

1. Introduction to Relays
2. Introduction to Test-Sets
3. Introduction to The Power System
4. How to Perform a Meter Test
5. Overcurrent Protection Theory (51/51)
6. How to Prepare for Relay Testing
7. Testing E-M Overcurrent Relays
 - a. 51 Overcurrent Pickup Tests
 - b. 51 Overcurrent Time Tests
 - c. 50 Overcurrent Pickup Tests

Day 2 Topics

1. E-M Relay Target Testing
2. Review E-M Relay Testing
3. Testing Digital Relays
4. Understanding Fault Types
5. Pickup Testing Options
6. Testing Ground Time Overcurrent (51N/51G/50N/50G)
7. Testing Phase Time Overcurrent (51P/50P)
8. Dynamic Testing Principles

Day 3 Topics

1. Digital Relay Testing Review
2. Digital Relay Testing Practice
3. Testing Overvoltage Elements (59)
4. Testing Undervoltage Elements (27)
5. Testing Under/Over Frequency Elements (27) **Optional
6. Testing Directional Overcurrent Elements (67) **Optional
7. Testing Synchronizing Elements (25) **Optional

Line Distance Protective Relay Testing Class

3-Day Class, 24 CEUs

Why do I want to take this class?

Utility environments and transformer relays can be more complicated than the simple feeder relays usually found in industrial environments. This class builds on the Protective Relay Testing Fundamentals Class to create relay testers who can test transmission line relays; such as:

- Directional Overcurrent Protection (67)
- Impedance Protection (21)
- Synch-Check (25) *Optional
- Schweitzer Engineering Laboratories
SEL-311x, 321, etc.
- General Electric UR Dx0, Fx0

Who should take this class?

Relay technicians who are comfortable testing overcurrent (51/51), over/under voltage (27/59), and over/under frequency (81) elements and want to test the majority of relays installed on the electrical system.



Which prerequisites are required?

Prospective students should have completed the Protective Relay Testing Fundamentals Class, or been approved by a Valence instructor.

Day 1 Topics

1. Introduction
 - a. Power Systems
 - b. Substation Configurations
 - c. Zones Of Protection
2. Testing Directional Overcurrent Elements (67)
3. Introduction to Distance Protection (21)
 - a. Line Impedance
 - b. Impedance Diagrams
 - c. Impedance Formulas

Day 2 Topics

1. Testing Zone-1 Distance Protection (21)
 - a. MTA Tests
 - b. Reach Tests
 - c. Timing Tests
2. Testing Zone-2 Distance Protection (21)
 - a. Three-Phase
 - b. Phase-Phase
 - c. Phase-Ground
3. Dynamic Relay Testing

Day 3 Topics

1. Testing Multi-Zone Protection Practice
2. Introduction To Synch-Check
3. Testing Synch-Check Relays
 - * Optional
 - a. Delta V
 - b. Undervoltage Block
 - c. Overvoltage Block
 - d. Delta Phase
 - e. Slip Frequency
 - f. DL/LB, LL/LB, LL/DB

End-To-End Communication Testing Class

2-Day Class, 16 CEUs

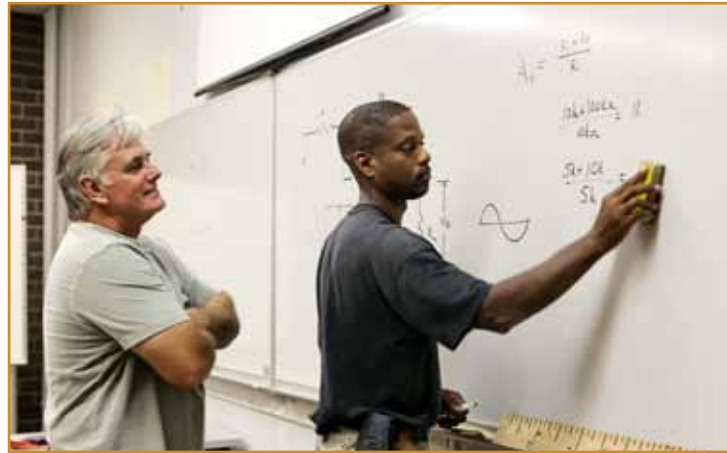
Why do I want to take this class?

Communication-assisted protection schemes are becoming increasingly common as technology improves. Testing these schemes requires specialized equipment and knowledge that is hard to find. This class builds on the Line Distance Protective Relay Testing Class to create relay testers who can perform end-to-end testing on communication-assisted transmission line relays, such as:

- Permissive Over-reaching Transfer Trip (POTT)
- Permissive Under-reaching Transfer Trip (PUTT)
- Directional Comparison Blocking (DCB)
- Schweitzer Engineering Laboratories
SEL-311x, 321, 421, etc.
- General Electric UR Dx0, Lx0

Who should take this class?

Relay technicians who are comfortable testing line distance/impedance elements and want to test communication-assisted trip schemes.



Which prerequisites are required?

Prospective students should have completed the Line Distance Protective Relay Testing Class or been approved by a Valence instructor.

Day 1 Topics

1. Introduction
 - a. What are Communication-Assisted Trip Schemes
 - b. What Is End-to-End Testing
2. Introduction to Test Cases
 - a. Fault Simulations
 - b. COMTRADE Files
3. End-to-End Test Procedures
 - a. Obtain and Review All Test Cases
 - b. Set up the GPS Antenna
 - c. Apply a Meter Test
 - d. Apply the Test Plan
 - e. Review the Results

Day 2 Topics

1. Test Direct Transfer Trip (DTT) Schemes
2. Test Direct Under-Reaching Transfer Trip (DUTT) Schemes
3. Test Permissive Over-Reaching Transfer Trip (POTT) Schemes
4. Test Permissive Under-Reaching Transfer Trip (PUTT) Schemes
5. Test Directional Comparison Blocking (DCB) Schemes
6. Test Differential Schemes

Differential Protective Relay Testing Class

2-Day Class, 16 CEUs

Why do I want to take this class?

Differential protection can be the most complicated relays to test because the test procedures are opposite of most other protective elements. Graduates of this class builds on the Protective Relay Fundamentals topics to help them understand and test all aspects of differential protection and relays, such as:

- Minimum Pickup
- Slope 1 / Slope 2
- Harmonic Restraint
- Phase Shifts Between Windings
- Schweitzer Engineering Laboratories
SEL-387, 787, 487 etc.
- General Electric UR Tx0, SR745

Who should take this class?

Relay technicians who are comfortable testing overcurrent (51/51) protection and want to understand and test differential relays.



Which prerequisites are required?

Prospective students should have completed the Protective Relay Testing Fundamentals Class, or been approved by a Valence instructor.

Day 1 Topics

1. What is Differential Protection
2. Differential Calculations
 - a. Tap
 - b. Per Unit
 - c. Operate/Restraint Current
 - d. Slope 1/Slope 2
3. Testing Differential Protection
 - a. Minimum Pickup
 - b. Slope 1
 - c. Slope 2

Day 2 Topics

1. Understanding Phase Shifts on Delta/Wye Transformers
 - a. Yy0 (YY), Dd0 (DDAB/DDAC)
 - b. Yd1 (YDAC), Dy1 (DABY)
2. Harmonic Restraint Testing
 - a. 2nd Harmonic
 - b. 5th Harmonic
3. Unrestrained Differential Testing
 - a. Minimum Pickup
 - b. Time Delay

Generator Protective Relay Testing Class

3-Day Class, 24 CEUs

Why do I want to take this class?

Generator relays are probably the most complex protective relays installed on the electrical system and have many different protection elements to protect the generator from various problems. Graduates of this class will build on the Protective Relay Fundamentals and Advanced class topics and will be able to test these additional elements and relays:

- Backup Overcurrent (51V)
- Reverse Power (32)
- Negative Sequence (46)
- Loss of Field (40)
- Volts per Hertz (24)
- Neutral Voltage (27TN/59N)
- Breaker Fail (50BF)
- Inadvertent Energization (50/27)
- Schweitzer Engineering Laboratories SEL-300G
- General Electric Multilin SR-489, G-x0
- Beckwith M-34xx



Who should take this class?

Relay technicians who are comfortable testing overcurrent (51/51), over/under voltage (27/59), over/under frequency (81), impedance (21), and differential (87) elements and want to test any generator relay.

Which prerequisites are required?

Prospective students should have completed the Protective Relay Testing Fundamentals and Advanced classes, or been approved by a Valence instructor.

Day 1 Topics

1. Introduction To Generators
2. Testing Overvoltage (59)
3. Testing Undervoltage (27)
4. Testing Under/Over Frequency (81)
5. Testing Impedance (21)
6. Testing Voltage Controlled / Restrained Overcurrent (51V)

Day 2 Topics

1. Testing Negative Sequence Overcurrent (46)
2. Testing Reverse Power (32)
3. Testing Loss Of Field (40)
4. Testing Volts/Hertz (24)
5. Testing Inadvertent Energization (50/27)
6. Testing Breaker Fail (50BF)

Day 3 Topics

1. Testing Differential (87)
2. Testing Neutral Overvoltage (59N)
3. Testing 100% Ground Protection (27TN)
4. Testing Out Of Step (78)
**Optional
5. Testing Synchro Relays (25)
**Optional

Testing Digital Relay Logic Testing Class

2-Day Class, 16 CEUs

Why do I want to take this class?

Version controlled electrical schematics used to be the method for determining what was supposed to happen inside a switchgear panel or control cabinet. Many, if not all, of these functions have been replaced with digital logic in digital relays, HMIs, and SCADA systems that all use different terminology and symbols to express their functions.

Relay testers can no longer open up the schematic drawing and get to work. They must be able to:

- Communicate with the relay or control device
- Translate all of the different logic schemes into something recognizable
- Functional test the logic scheme to ensure it will work correctly in the application

Who should take this class?

Relay technicians who are comfortable testing protective relay elements and want to test the entire relay.

Which prerequisites are required?

Prospective students should have completed the Protective Relay Testing Fundamentals class or been approved by a Valence instructor.

DESCRIPTOR	SYMBOL	MATRIX	ELECTRICAL EQUIVILANT
OR		1 1 0 1	
		1 0 1 1	
		0 1 1 0	
AND		1 1 1 1	
		1 0 0 0	
		0 1 0 0	
NOT		0 1 1	
		1 0 0	
		1 1 0	
NOR		1 1 0 0	
		1 0 1 0	
		0 1 1 0	
NAND		1 1 0 0	
		1 0 1 0	
		0 1 1 0	
XOR		1 1 0 0	
		1 0 1 0	
		0 1 1 0	
XNOR		1 1 1 0	
		1 0 0 0	
		0 1 1 0	

Day 1 Topics

1. Introduction to Symbols
 - a. Contacts vs. Switches
 - b. Timing vs. Latching Relays
 - c. Normally Open vs. Normally Closed
 - d. Fail-Safe vs. Non Fail-Safe
2. Introduction to Schematics
 - a. Trip Circuits
 - b. Close Circuits
 - c. Anti-Pump Circuits
 - d. Seal-In Circuits
3. Introduction to Logic Gates
 - a. OR Gates
 - b. AND Gates
 - c. Not

Day 2 Topics

1. Introduction to Relay Digital Logic
 - a. Element Schemes (GE SR Relays)
 - b. Binary Schemes (Alstom Relays)
 - c. Grid Schemes (Siemens / Beckwith Relays)
 - d. Arithmetic Schemes (SEL Relays)
 - e. Gate Schemes (GE UR / ABB Relays)
2. Converting Between Logic Schemes
3. Testing Logic Schemes
 - a. Traditional trip Schemes
 - b. Conditional Trip Schemes
 - c. Breaker Fail Trip Schemes
 - d. Conditional Closing Schemes
 - e. Synchronizing Logic Schemes

Motor Protective Relay Testing Class

2-Day Class, 16 CEUs

Why do I want to take this class?

Motor protection relays could be the most common relay found at any industrial site and they have very specific protection features because of the induction motor's unique operating characteristics. Graduates of this class will build on the Protective Relay Testing Fundamentals and/or Advanced class topics and will be able test these additional elements and relays:

- Overload (49)
- Start Blocking
- Mechanical Jam
- Acceleration Trip
- Unbalanced Overcurrent
- RTD Testing
- Schweitzer Engineering Laboratories
SEL-701, SEL-749
- General Electric Multilin SR-x69



Who should take this class?

Relay technicians who are comfortable testing overcurrent (51/51), over/under voltage (27/59), and over/under frequency (81) elements and want to test motor protection relays.

Which prerequisites are required?

Prospective students should have completed the Protective Relay Testing Fundamentals class or been approved by a Valence instructor.

Day 1 Topics

1. Introduction
2. Meter Testing
3. Overload Trip Protection (49T)
4. Overload Alarm Protection (49A)
5. Starts Per Hour / Time Between Starts Blocking
6. Mechanical Jam Protection
7. Acceleration Trip Protection

Day 2 Topics

1. Previous Day Review
2. Unbalance Alarm
3. Unbalance Trip
4. Short Circuit Protection (50)
5. Ground Fault Alarm Protection (50G)
6. Ground Fault Trip Protection (50G)

Day 3 Topics

1. Previous Days Review
2. Differential Protection (87)
3. Overvoltage Protection (59)
4. Undervoltage Protection (27)
5. Over Frequency Protection (81)
6. Under Frequency Protection (81)
7. Rtd Protection

Frequently Asked Questions (FAQ)

Are your instructors qualified?

All of our instructors started in the field testing relays and have extensive experience with manufacturers, models, test-sets, and relays. They are industry leaders and have recurring instructor/presenter/author/contributor roles at major industry events and organizations such as:

- InterNational Electrical Testing Association (NETA)
 - Powertest Conference
 - NETA World Magazine
- Western Institute Hands-On Relay School
- TEGG
- Pacific Gas and Electric
- MidAmerican Energy
- Xcel Energy
- Transalta Utilities
- USACE
- Seattle City Light

How Do the Classes Work?

We schedule a three-day time for our instructor to come to your classroom/boardroom setting free from distractions with a projection system and whiteboards. We can have up to five workstations that include:

- A maximum of two students.
- The appropriate relay for the class. (We can supply relays for all classes if spares are not available.)
- A protective relay test-set provided by you.
- A laptop supplied by you with your test-set and relay software pre-installed and updated.
- Test leads and communication cables provided by you.
- Three-line drawings, single-line drawing, schematics, and logic diagrams from a previous or future job.

How Much does a Class Cost?

We can provide an all-inclusive quote (usually between \$6,500 - 8,000 USD, depending on your location) for training at your location.

How Many Students can Attend?

We typically recommend a maximum of 10 students for the most effective learning environment.

Which kind of credits are provided?

You will get a certificate of completion after every class that you can use for continuing education credits from the appropriate organizations. We have been pre-approved for CTD credits from the InterNational Electrical Testing Association (NETA) as indicated in the header of each class page. We will work with you as much as we can to get approval from your accreditation organization.

How do I sign up for a class?

Use the online form at <https://relaytraining.com/relay-tesing-training-courses/request-training-course-information/> to register or contact us at store@relaytraining.com or 303-250-8257, and we'll contact you.



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ELECTRICAL TRAINING SERVICES

5005 S Kipling Pkwy Suite A7 PMB 395
Littleton, CO 80127-1375
1-303-250-8257

RelayTraining.com
store@relaytraining.com

